ENGINEERING •GEOTECHNICAL •ENVIRONMENTAL (ESA I & II) •
MATERIALS TESTING •SPECIAL INSPECTIONS •
ORGANIC CHEMISTRY • PAVEMENT
DESIGN •GEOLOGY

GEOLOGICAL/GEOTECHNICAL ENGINEERING STUDY

Skylodge Additions at Powder Mountain

7600 East Powder Ridge Road
Eden, Utah
CMT PROJECT NO. 19513

FOR:
Radify Powder Mountain, LLC
249 Main Avenue South, Suite 107-362
North Bend, Washington 98045

December 16, 2022

CMT TECHNICAL SERVICES

December 16, 2022

Radify Powder Mountain, LLC
Attn: Laron Turley
249 Main Avenue South, Suite 107-362
North Bend, Washington 98045

Subject: Geological/Geotechnical Engineering Study
Skylodge Additions at Powder Mountain
7600 East Powder Ridge Road
Eden, Utah
CMT Project No. 19513

Dear Laron:

Submitted herewith is the report of our geological/geotechnical engineering study for the subject site. This report contains the results of our findings and interpretation of the results with respect to the available project characteristics. It also contains recommendations to aid in the design and construction of the earth related phases of this project.

On November 15, 2022, a CMT Technical Services (CMT) staff professional was on-site and supervised the excavation of 10 test pits extending to depths of about 4 to 10 feet below the existing ground surface. We obtained soil samples during the field operations that we subsequently transported to our laboratory for further testing and observation.

Conventional spread and/or continuous footings may be utilized to support the proposed structures, provided the recommendations in this report are followed. This report presents detailed discussions of design and construction criteria for this site.

We appreciate the opportunity to work with you at this stage of the project. CMT offers a full range of Geotechnical Engineering, Geological, Material Testing, Special Inspection services, and Phase I and II Environmental Site Assessments. With offices throughout Utah, Idaho, Arizona, Colorado and Texas, our staff is capable of efficiently serving your project needs. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at 801-492-4132.

Sincerely,
CMT Technical Services

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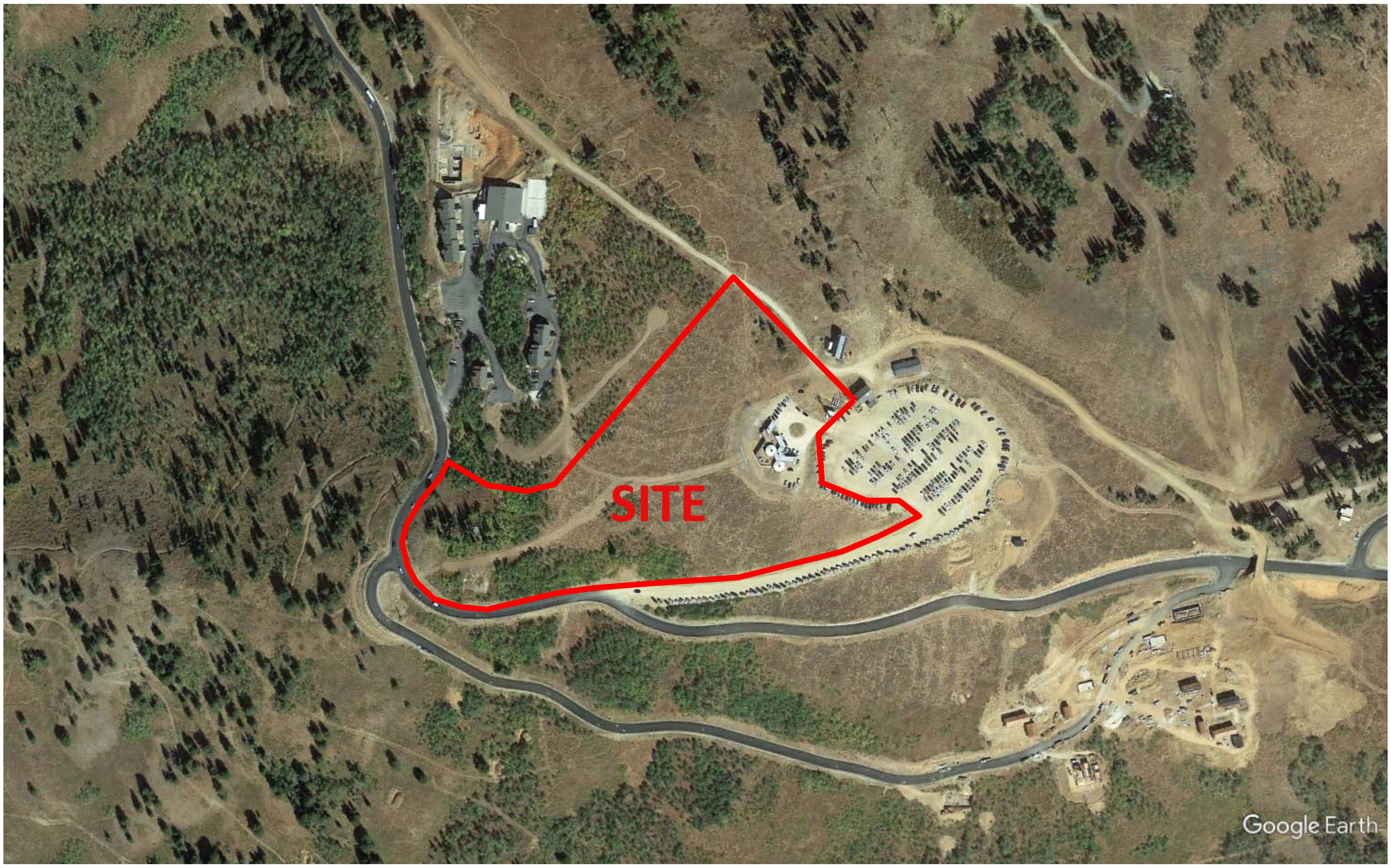
1.0 INTRODUCTION

1.1 General

CMT Technical Services (CMT) was retained to conduct a geological/geotechnical subsurface study for the proposed addition and construction of buildings and cabins. The parcel is situated on the north side of Powder Ridge Road at approximately 7600 East in Eden, Utah, as shown in the **Vicinity Map** below.



VICINITY MAP

1.2 Objectives, Scope and Authorization

The objectives and scope of our study were planned in discussions between Ms. Lisa Webster of NVGTE, and Mr. Bill Turner of CMT. In general, the objectives of this study were to define and evaluate the subsurface soil and groundwater conditions at the site, and provide appropriate foundation, earthwork, pavement and seismic recommendations to be utilized in the design and construction of the proposed development.

In accomplishing these objectives, our scope of work included performing field exploration, which consisted of the excavating/logging/sampling of 10 test pits, performing laboratory testing on representative samples of the subsurface soils collected in the test pits, and conducting an office program, which consisted of correlating available data, performing engineering analyses, and preparing this summary report. This scope of work was authorized by returning a signed copy of our proposal dated October 28, 2022 and executed on November 1, 2022.

1.3 Description of Proposed Construction

We understand that the project will consist of constructing an addition to the existing lodge building, four guest buildings and thirty guest cabins at the site. We anticipate the structures will be 1 to 2 stories in height above existing grade, with a possible level below grade (full to partial basements), and project that maximum loads will be 8,000 pounds per lineal foot for walls, 150,000 pounds for columns, and 150 pounds per square foot for floors. If the loading conditions are different than we have projected, please notify us so that any appropriate modifications to our conclusions and recommendations contained herein can be made.

We also understand that pavements at the site include light-duty parking areas and internal drive lanes, which we anticipate will utilize asphalt pavement. Traffic is projected to consist of mostly automobiles and light trucks, a few daily medium-weight delivery trucks, a weekly garbage truck, and an occasional fire truck.

Site development will require some earthwork in the form of minor cutting and filling. A site grading plan was not available at the time of this report, but we project that maximum cuts and fills may be on the order of 2 to 5 feet. If deeper cuts or fills are planned, CMT should be notified to provide additional recommendations, if needed.

1.4 Executive Summary

The most significant geotechnical aspects regarding site development include the following:

1. Approximately 6 inches of topsoil blankets the site, which will require removal beneath structures, flatwork and pavements;
2. Subsurface soils encountered primarily consisted of GRAVEL with varying amounts of clay, silt and sand (GC, GC-GM, GM) and with cobbles that graded to boulders, and Silty SAND with gravel (SM), as well as a layer of Gravelly CLAY (CL), while groundwater was not encountered to the maximum depth explored of 10 feet;
3. Excavation refusal was encountered in the test pits (except TP-10) at depths of 4 to 6 feet below the existing ground surface;
4. A relatively small portion in the south central area of the site is located within a landslide, and buildings should not be placed within the landslide area or within 40 feet of the landslide scarp;
5. Foundations and floor slabs may be placed on suitable, undisturbed natural soils or on properly placed and compacted structural fill extending to suitable, undisturbed natural soils.

CMT must assess that topsoil, undocumented fills, debris, disturbed or unsuitable soils have been removed and that suitable soils have been encountered prior to placing site grading fills, footings, slabs, and pavements.

In the following sections, detailed discussions pertaining to the site are provided, including subsurface descriptions, geologic/seismic setting, earthwork, foundations, lateral resistance, lateral pressure, floor slabs, and pavements.

2.0 FIELD EXPLORATION

2.1 General

In order to define and evaluate the subsurface soil and groundwater conditions, 10 test pits were excavated with a backhoe at the site to depths of approximately 4 to 10 feet below the existing ground surface. Locations of the test pits are shown on ***Figure 1, Site Plan***, included in the Appendix. Except for test pit TP-10, which extended to a depth of about 10 feet, excavation refusal was encountered in the test pits at depths of 4 to 6 feet. The field exploration was performed under the supervision of an experienced member of our geotechnical staff.

Representative soil samples were collected by obtaining disturbed "grab" samples from within each test pit. The samples were placed in sealed plastic bags and containers prior to transport to the laboratory.

The subsurface soils encountered in the test pits were classified in the field based upon visual and textural examination, logged and described in general accordance with ASTM[1] D-2488. These field classifications were supplemented by subsequent examination and testing of select samples in our laboratory. Graphical representations of the subsurface conditions encountered are presented on each individual Test Pit Log, ***Figures 2 through 11***, included in the Appendix. A Key to Symbols defining the terms and symbols used on the logs, is provided as ***Figure 12*** in the Appendix.

Upon completion of logging and sampling, the test pits were backfilled with the excavated soils. When backfilling, minimal to no effort was made to compact the backfill and no compaction testing was performed. Thus, the test pit backfill is considered undocumented fill and settlement of the backfill in the test pits over time should be anticipated.

3.0 LABORATORY TESTING

Selected samples of the subsurface soils were subjected to various laboratory tests to assess pertinent engineering properties, as follows:

1. Moisture Content, ASTM D-2216, Percent moisture representative of field conditions
2. Atterberg Limits, ASTM D-4318, Plasticity and workability
3. Gradation Analysis, ASTM D-1140/C-117, Grain Size Analysis

Laboratory test results are presented on the test pit logs (***Figures 2 through 11***) and in the following **Lab Summary Table**:

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[1] American Society for Testing and Materials

LAB SUMMARY TABLE

TEST PIT	DEPTH (feet)	SOIL CLASS	SAMPLE TYPE	MOISTURE CONTENT(%)	GRADATION			ATTERBERG LIMITS		
					GRAV.	SAND	FINES	LL	PL	PI
TP-1	2	GC	Bag	11	45	27	28			
	3.5	GC-GM	Bag	3	53	24	23	26	19	7
TP-2	2	GC	Bag	8	37	31	32			
	5	GC-GM	Bag	27	52	25	23			
TP-3	1	GM	Bag	7	41	33	26		NP	NP
	3	GM	Bag	5	51	26	23			
TP-4	4	GM	Bag	9	39	30	31			
TP-5	5.5	GC	Bag	6	31	29	40	27	15	12
TP-6	2	GC	Bag	9	47	27	26			
TP-7	4.5	GC-GM	Bag	4	56	23	21	20	14	6
TP-8	2	GC	Bag	10	47	30	23			
TP-9	4	CL	Bag	6	44	2	54	23	15	8
TP-10	9.5	SM	Bag	3	34	37	29			

4.0 GEOLOGIC & SEISMIC CONDITIONS

4.1 Geologic Setting

The subject site is located in the Southern Bear River Range in north-central Utah at an elevation of between approximately 8,790 and 8,920 feet above sea level. The north-south trending Bear River Range extends north approximately 90 miles into southeastern Idaho. The site is located on a west-southwest trending and gently plunging ridge at the head of the South Fork of Wolf Creek. This drainage flows south-southwest and empties into the Ogden Valley.

The geology of the USGS 30' x 60' Ogden Quadrangle, including the location of the subject site, has been mapped by Coogan and King[2]. The surficial geology at the subject site is predominantly comprised of bedrock the Wasatch Formation (Map Unit Tw) dated Eocene and upper Paleocene. Western portions of the site are underlain by bedrock of the St. Charles Formation (Map Unit Csc) dated Lower Ordovician and Upper Cambrian. Portions of the flanks of the ridge to the northwest and south of the site are mapped to be covered with landslide deposits (Map Unit Qms) and landslide deposits and colluvium (Map Unit Qmc). These mass-movement deposits are dated Holocene and Pleistocene. No fill has been mapped at the location of the site on the geologic map. Refer to the **Geologic Map**, shown below. Descriptions of the mapped (Coogan and King, 2016) geologic units at the site follow.

Qms - Landslide deposits: Poorly sorted clay- to boulder-sized material; generally characterized by hummocky topography, main and internal scarps, and chaotic bedding in displaced blocks.

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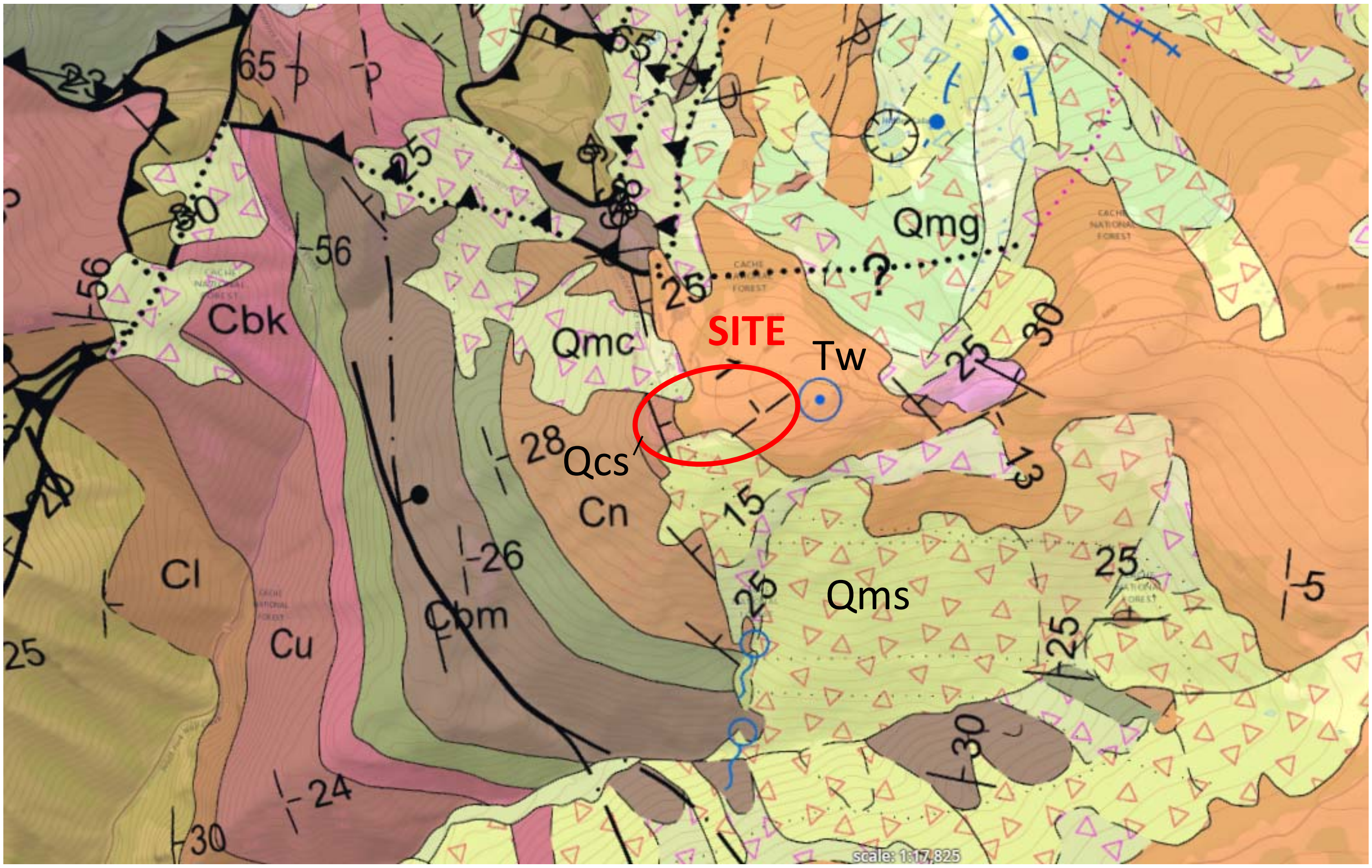
[2] Coogan, J.C., and King, J.K., 2016, Interim Geologic Map of the Ogden 30' x 60' Quadrangle, Box Elder, Cache, Davis, Morgan, Rich, and Summit Counties, Utah, and Uinta County, Wyoming; Utah Geological Survey Open-File Report 653DM, Scale 1:62,500.

Qmc - Landslide and colluvial deposits, undivided: Poorly sorted to unsorted clay- to boulder-sized material; includes landslide and colluvium; locally includes talus and debris flow deposits.

Tw – Wasatch Formation: Typically red to brownish-red sandstone, siltstone, mudstone, and conglomerate with minor gray limestone and marlstone locally (see Twl); lighter shades of red, yellow, tan, and light gray present locally and more common in uppermost part, complicating mapping of contacts with overlying similarly colored Norwood and Fowkes Formations; clasts typically rounded Neoproterozoic and Paleozoic sedimentary rocks, mainly Neoproterozoic and Cambrian quartzite; basal conglomerate more gray and less likely to be red, and containing more locally derived angular clasts of limestone, dolomite and sandstone, typically from Paleozoic strata, for example in northern Causey Dam quadrangle; sinkholes indicate karstification of limestone beds.

Csc – St. Charles Formation: Mostly dark-gray, medium- to thick-bedded dolomite; contains subordinate medium-gray dolomite and limestone; all with tan-weathering mottling and recesses of crude laminae to inch-scale layers of sandstone and siltstone; overall gray to tan weathering and ledge forming; uppermost part contains light-colored, typically pink, chert; lower part is less resistant, light-gray, tannish-gray weathering, thin-bedded, silty and sandy limestone and dolomite, and silty shale, with tannish-gray, medium-bedded, cross-bedded Worm Creek Quartzite Member (Upper Cambrian) that is locally present.



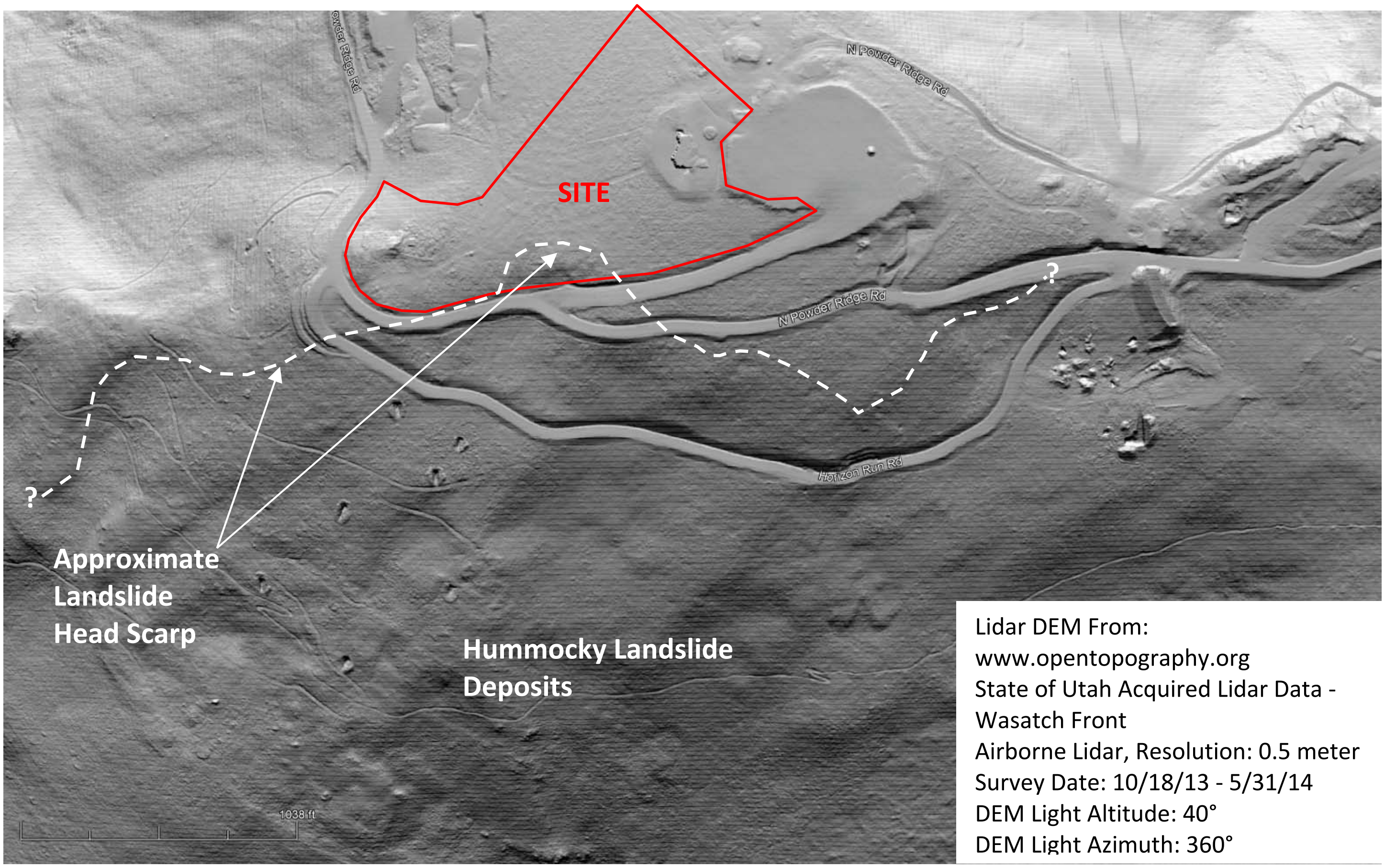
GEOLOGIC MAP

4.2 Faulting

No surface fault traces are shown on the referenced geologic map crossing or projecting toward the subject site. The nearest mapped active (Holocene) fault trace is the Weber segment of the Wasatch Fault Zone located about 9.3 miles east of the site. Seismic design issues are addressed in **Section 4.4** below.

4.3 Other Geologic Hazards

The subject site is not located within a currently mapped or observed potential debris flow, stream flooding, or rock fall hazard area. However, landslide deposits (Unit Qms, see **Section 4.1**) are mapped on the flank of the ridge to the south of the subject site. We reviewed modern Lidar (light detection and ranging) digital elevation models (DEM) inclcuding the site and surrounding areas; one Lidar DEM is included below.



Lidar DEM From:
www.opentopography.org
State of Utah Acquired Lidar Data - Wasatch Front
Airborne Lidar, Resolution: 0.5 meter
Survey Date: 10/18/13 - 5/31/14
DEM Light Altitude: 40°
DEM Light Azimuth: 360°

Lidar DEM

As annotated in the Lidar DEM above, an apparent landside head scarp extends into the south-central portion of the subject site. Terrain to the south of the head scarp is hummocky in appearance with evidence of numerous internal scarps and slumps. CMT recommends avoiding placement of structures designed for human occupancy across or south of the head scarp. A minimum building setback of 40 feet is also recommended to the north and northwest of the head scarp.

4.4 Seismicity

4.4.1 Site Class

Utah has adopted the International Building Code (IBC) 2018, which determines the seismic hazard for a site based upon 2014 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class. The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points). For site class definitions, IBC 2018 Section 1613.2.2 refers to Chapter 20, Site Classification Procedure for Seismic Design, of ASCE[3] 7-16, which stipulates that the average values of shear wave velocity, blow count and/or shear strength within the upper 100 feet (30 meters) be utilized to determine seismic site class. Based on average shear wave velocity data within the upper 30 meters ($V_{S,30}$) published by McDonald and Ashland[4], the subject site is located within unit description "P", which has a log-mean $V_{S,30}$ of 2,197 meters per second (7,208 feet per second). Thus, it is our opinion the site best fits Site Class B – Rock Profile (estimated), which we recommend for seismic structural design.

4.4.2 Ground Motions

The 2014 USGS mapping utilized by the IBC provides values of peak ground, short period and long period spectral accelerations for the Site Class B/C boundary and the Risk-Targeted Maximum Considered Earthquake (MCE_R). This Site Class B/C boundary represents average bedrock values for the Western United States and must be corrected for local soil conditions at site grid coordinates of 41.3693 degrees north latitude and -111.7657 degrees west longitude. The following table and response spectra summarizes the peak ground, short period and long period accelerations for the MCE_R event, and incorporates appropriate soil correction factors for a Site Class B (estimated) soil profile:

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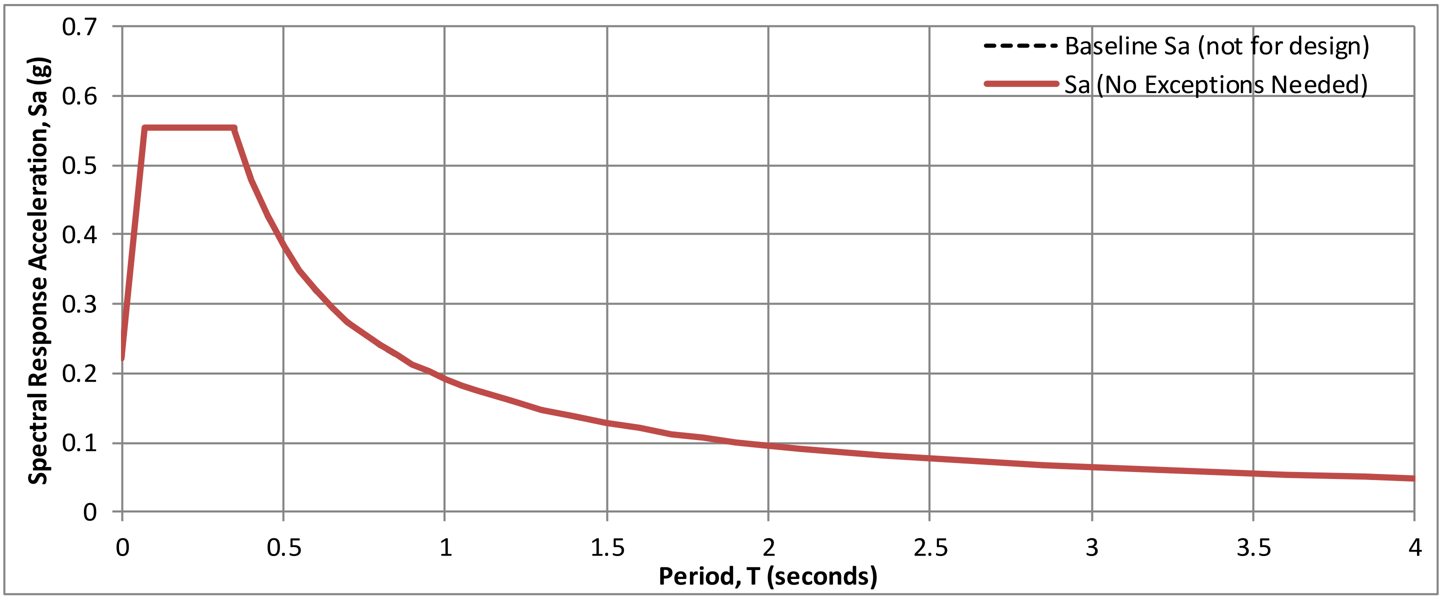
[3] American Society of Civil Engineers

[4] McDonald, G.N. and Ashland, F.X., 2008, "Earthquake Site-Conditions Map for the Wasatch Front Urban Corridor, Utah," Utah Geological Survey Special Study 125, 41 pp.

SPECTRAL ACCELERATION PERIOD, T	**SITE CLASS B/C BOUNDARY [mapped values] (g)**	**SITE COEFFICIENT**	**SITE CLASS B* [adjusted for site class effects] (g)**	**MULTI-PLIER**	**DESIGN VALUES (g)**
Peak Ground Acceleration	PGA = **0.362**	F_{pga} = 1.000	PGA_M = 0.362	1.000	PGA_M = 0.362
0.2 Seconds (Long Period Acceleration)	S_S = **0.830**	F_a = 1.000	S_{MS} = 0.830	0.667	S_{DS} = 0.553
	(no exceptions needed)	F_a = (N/A)	S_{MS} = (N/A)	0.667	S_{DS} = (N/A)
1.0 Second (Long Period Acceleration)	S_1 = **0.288**	F_v = 1.000	S_{M1} = 0.288	0.667	S_{D1} = 0.192
	(no exceptions needed)	F_v = (N/A)	S_{M1} = (N/A)	0.667	S_{D1} = (N/A)

NOTES: 1. TL (seconds): **8**
2. Site Class: **B**
3. Have data to verify? **no**
4. No Exceptions Needed
*** Site Class B Without Measurements**



4.4.3 Liquefaction

Liquefaction is defined as the condition when saturated, loose, sandy soils lose their support capabilities because of excessive pore water pressure which develops during a seismic event. Clayey soils, even if saturated, will generally not liquefy during a major seismic event.

Subsurface soils encountered consisted primarily of dense sand to gravel soils, while groundwater was not encountered. These conditions indicate that liquefaction of these soils is not likely to occur.

5.0 SITE CONDITIONS

5.1 Surface Conditions

At the time the test pits were excavated the site consisted of the existing ski lodge, with vacant land at the proposed guest building locations. Based upon aerial photos dating back to 1993 that are readily available on the internet, the existing lodge was constructed between 2011 and 2014, but prior to 2011 the site was vacant land. Overall, the site is slopes moderately downward to the west. The site is bordered on the north by a road, on the east by an unpaved parking lot, and on the south and west by Powder Ridge Road (see **Vicinity Map** in **Section 1.1** above).

5.2 Subsurface Soils

At the locations of the test pits, we encountered approximately 6 inches of topsoil at the surface. We observed natural soils beneath the topsoil, consisting of GRAVEL with varying amounts of clay, silt and sand (GC, GC-GM, GM) and cobbles that graded to boulders, and Silty SAND with gravel (SM), as well as a layer of Gravelly CLAY (CL), extending to the maximum depth penetrated of approximately 10 feet. The clay soils were slightly moist, reddish in color, and estimated to be stiff in consistency. The natural gravel and sand soils were slightly moist to moist, brown to light brown to red brown to red in color, and estimated to be medium dense to dense. They will also exhibit moderately high strength and low compressibility characteristics.

For a more descriptive interpretation of subsurface conditions, please refer to the test pit logs, ***Figures 2 through 11***, which graphically represent the subsurface conditions encountered. The lines designating the interface between soil types on the logs generally represent approximate boundaries - in situ, the transition between soil types may be gradual.

5.3 Groundwater

We did not encounter groundwater at the time of our field explorations within the maximum depth explored of about 10 feet below the existing ground surface. Therefore, we do not anticipate that groundwater will affect the proposed construction.

Groundwater levels can fluctuate seasonally. Numerous other factors such as heavy precipitation, irrigation of neighboring land, and other unforeseen factors, may also influence ground water elevations at the site. The detailed evaluation of these and other factors, which may be responsible for ground water fluctuations, is beyond the scope of this study.

5.4 Site Subsurface Variations

Based on the results of the subsurface explorations and our experience, variations in the continuity and nature of subsurface conditions should be anticipated. Due to the heterogeneous characteristics of natural soils, care should be taken in interpolating or extrapolating subsurface conditions between or beyond the exploratory locations.

Also, after completing the logging and sampling, the test pits were backfilled with the excavated soils but minimal to no effort was made to compact these soils. Thus, the test pit backfill is considered undocumented fill and settlement of the backfill in the test pits over time should be anticipated.

6.0 SITE PREPARATION AND GRADING

6.1 General

All deleterious materials should be stripped from the site prior to commencement of construction activities. This includes loose and disturbed soils, topsoil, vegetation, etc. Based upon the conditions observed in the test pits there is topsoil on the surface of the site which we estimated to be about 6 inches in thickness. When stripping and grubbing, topsoil should be distinguished by the apparent organic content and not solely by color; thus we estimate that topsoil stripping will need to include the upper 4 inches.

We anticipate that some undocumented fill may be present around the existing lodge buildings. All undocumented fill shall be removed from beneath structures, but may remain beneath exterior flatwork and pavements, provided they are properly prepared and the owner understands that additional maintenance may be required. Outside of building footprints, proper preparation of undocumented fill and disturbed soils shall consist of removing the upper 12 inches, scarifying to a minimum depth of 8 inches and compacting the soils in place. The exposed subgrade must then be proofrolled by passing moderate-weight rubber tire-mounted construction equipment over the surface at least twice. If excessively soft or loose soils are encountered, they must be removed (up to a maximum depth of 2 feet) and replaced with structural fill.

The site should be observed by a CMT geotechnical engineer to assess that suitable natural soils have been exposed and any deleterious materials, loose and/or disturbed soils have been removed, prior to placing site grading fills, footings, slabs, and pavements.

Fill placed over large areas to raise overall site grades can induce settlements in the underlying natural soils. If more than 5 feet of site grading fill is anticipated over the natural ground surface, we should be notified to assess potential settlements and provide additional recommendations as needed. These recommendations may include placement of the site grading fill far in advance to allow potential settlements to occur prior to construction.

6.2 Temporary Excavations

Excavations deeper than 8 feet are not anticipated at the site. Groundwater was not encountered within the depths explored, about 4 to 10 feet at the time of our field explorations, and thus is not anticipated to affect excavations.

The natural soils encountered at this site predominantly consisted of sand/gravel. For sandy/gravelly (cohesionless) soils, temporary construction excavations not exceeding 4 feet in depth should be no steeper than one-half horizontal to one vertical (0.5H:1V). For excavations up to 8 feet and above groundwater, side slopes should be no steeper than one horizontal to one vertical (1H:1V). Excavations encountering saturated cohesionless soils will be very difficult to maintain, and will require very flat side slopes and/or shoring, bracing and dewatering.

In clayey (cohesive) soils, temporary construction excavations not exceeding 4 feet in depth may be constructed with near-vertical side slopes. Temporary excavations up to 8 feet deep, above or below groundwater, may be constructed with side slopes no steeper than one-half horizontal to one vertical (0.5H:1V).

All excavations must be inspected periodically by qualified personnel. If any signs of instability or excessive sloughing are noted, immediate remedial action must be initiated. All excavations should be made following OSHA safety guidelines.

6.3 Fill Material

Following are our recommendations for the various fill types we anticipate will be used at this site:

FILL MATERIAL TYPE	DESCRIPTION | RECOMMENDED SPECIFICATION
Structural Fill	Placed below structures, flatwork and pavement. Well-graded sand/gravel mixture, with maximum particle size of 4 inches, a minimum 70% passing 3/4-inch sieve, a maximum 20% passing the No. 200 sieve, and a maximum Plasticity Index of 10.
Site Grading Fill	Placed over larger areas to raise the site grade. Sandy to gravelly soil, with a maximum particle size of 6 inches, a minimum 70% passing 3/4-inch sieve, a maximum 50% passing No. 200 sieve, and a maximum Plasticity Index of 15.
Non-Structural Fill	Placed below non-structural areas, such as landscaping. On-site soils or imported soils, with a maximum particle size of 8 inches, including silt/clay soils not containing excessive amounts of degradable/organic material (see discussion below).
Stabilization Fill	Placed to stabilize soft areas prior to placing structural fill and/or site grading fill. Coarse angular gravels and cobbles 1 inch to 8 inches in size. May also use 1.5-inch to 2.0-inch gravel placed on stabilization fabric, such as Mirafi RS280i, or equivalent (see **Section 6.6**).

On-site sand and gravel soils do not appear suitable for use as structural fill but may be used as site grading fill and non-structural fill.

On-site clay soils are not suitable for use as structural fill or site grading fill, but may be used as non-structural fill. Note that these silt/clay soils are moisture-sensitive, which means they are inherently more difficult to work with in proper moisture conditioning (they are very sensitive to changes in moisture content), requiring very close moisture control during placement and compaction. This will be very difficult, if not impossible, during wet and cold periods of the year.

All fill material should be approved by a CMT geotechnical engineer prior to placement.

6.4 Fill Placement and Compaction

The various types of compaction equipment available have their limitations as to the maximum lift thickness that can be compacted. For example, hand operated equipment is limited to lifts of about 4 inches and most “trench compactors” have a maximum, consistent compaction depth of about 6 inches. Large rollers, depending on soil and moisture conditions, can achieve compaction at 8 to 12 inches. The full thickness of each lift should be compacted to at least the following percentages of the maximum dry density as determined by ASTM D-1557 (or AASHTO[5] T-180) in accordance with the following recommendations:

LOCATION	TOTAL FILL THICKNESS (FEET)	MINIMUM PERCENTAGE OF MAXIMUM DRY DENSITY
Beneath an area extending at least 4 feet beyond the perimeter of structures, and below flatwork and pavement (applies to structural fill and site grading fill) extending at least 2 feet beyond the perimeter	0 to 5 5 to 8	95 98
Site grading fill outside area defined above	0 to 5 5 to 8	92 95
Utility trenches within structural areas	--	96
Roadbase and subbase	-	96
Non-structural fill	0 to 5 5 to 8	90 92

Structural fills greater than 8 feet thick are not anticipated at the site. For best compaction results, we recommend that the moisture content for structural fill/backfill be within 2% of optimum. Field density tests should be performed on each lift as necessary to verify that proper compaction is being achieved.

6.5 Utility Trenches

For the bedding zone around the utility, we recommend utilizing sand bedding fill material that meets current APWA[6] requirements.

All utility trench backfill material below structurally loaded facilities (foundations, floor slabs, flatwork, parking lots/drive areas, etc.) should be placed at the same density requirements established for structural fill in the previous section.

Most utility companies and local governments are requiring Type A-1a or A-1b (AASHTO Designation) soils (sand/gravel soils with limited fines) be used as backfill over utilities within public rights of way, and the backfill be compacted over the full depth above the bedding zone to at least 96% of the maximum dry density as determined by AASHTO T-180 (ASTM D-1557). The natural sand and gravel soils at this site will not likely meet these specifications.

Where the utility does not underlie structurally loaded facilities and public rights of way, natural soils may be utilized as trench backfill above the bedding layer, provided they are properly moisture conditioned and compacted to the minimum requirements stated above in **Section 6.4**.

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[5] American Association of State Highway and Transportation Officials
[6] American Public Works Association

6.6 Soft Soil Stabilization

If rutting or pumping occurs, traffic should be stopped and the disturbed soils should be removed and replaced with stabilization material. Typically, a minimum of 18 inches of the disturbed soils must be removed to be effective. However, deeper removal is sometimes required.

To stabilize soft subgrade conditions (if encountered), a mixture of coarse, clean, angular gravels and cobbles and/or 1.5- to 2.0-inch clean gravel should be utilized, as indicated above in **Section 6.3**. Often the amount of gravelly material can be reduced with the use of a geotextile fabric such as Mirafi RS280i or equivalent. Its use will also help avoid mixing of the subgrade soils with the gravelly material. After excavating the soft/disturbed soils, the fabric should be spread across the bottom of the excavation and up the sides a minimum of 18 inches. Otherwise, it should be placed in accordance with the manufacturer's recommendation, including proper overlaps. The gravel material can then be placed over the fabric in compacted lifts as described above.

7.0 FOUNDATION RECOMMENDATIONS

The following recommendations have been developed on the basis of the previously described project characteristics, including the maximum loads discussed in **Section 1.3**, the subsurface conditions observed in the field and the laboratory test data, and standard geotechnical engineering practice.

7.1 Foundation Recommendations

Based on our geotechnical engineering analyses, the proposed structures may be supported upon conventional spread and/or continuous wall foundations placed on undisturbed natural sand/gravel soils and/or on structural fill extending to natural soils. Footings may be designed using a net bearing pressure of 3,000 psf. The term "net bearing pressure" refers to the pressure imposed by the portion of the structure located above lowest adjacent final grade, thus the weight of the footing and backfill to lowest adjacent final grade need not be considered. The allowable bearing pressure may be increased by 1/3 for temporary loads such as wind and seismic forces.

We also recommend the following:

1. Exterior footings subject to frost should be placed at least 30 inches below final grade.
2. Interior footings not subject to frost should be placed at least 16 inches below grade.
3. Continuous footing widths should be maintained at a minimum of 18 inches.
4. Spot footings should be a minimum of 24 inches wide.

7.2 Installation

Under no circumstances shall foundations be placed on undocumented fill, topsoil with organics, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

Deep, large roots may be encountered where trees and larger bushes are located or were previously located at the site; such large roots should be removed. If other unsuitable soils are encountered, they must be completely removed and replaced with properly compacted structural fill. Excavation bottoms should be examined by a CMT geotechnical engineer to confirm that suitable bearing soils have been exposed.

All structural fill should meet the requirements for such, and should be placed and compacted in accordance with **Section 6** above. The width of structural replacement fill below footings should be equal to the width of the footing plus 1 foot for each foot of fill thickness. For instance, if the footing width is 2 feet and the structural fill depth beneath the footing is 2 feet, the fill replacement width should be 4 feet, centered beneath the footing.

The minimum thickness of structural fill below footings should be equivalent to one-third the thickness of structural fill below any other portion of the foundations. For example, if the maximum depth of structural fill is 6 feet, all footings for the new structure should be underlain by a minimum 2 feet of structural fill.

7.3 Estimated Settlement

Foundations designed and constructed in accordance with our recommendations could experience some settlement, but we anticipate that total settlements of footings founded as recommended above will not exceed 1 inch, with differential settlements on the order of 0.5 inches over a distance of 25 feet. We expect approximately 50% of the total settlement to initially take place during construction.

7.4 Lateral Resistance

Lateral loads imposed upon foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footings and the supporting soils. In determining frictional resistance, a coefficient of 0.40 for natural sand/gravel soils and structural fill may be utilized for design. Passive resistance provided by properly placed and compacted structural fill above the water table may be considered equivalent to a fluid with a density of 350 pcf. A combination of passive earth resistance and friction may be utilized if the passive resistance component of the total is divided by 1.5.

8.0 LATERAL EARTH PRESSURES

We project that below-grade walls up to 8 feet tall might be constructed at this site. The lateral earth pressure values given below anticipate that on-site sand/gravel soils will be used as backfill material, placed and compacted in accordance with the recommendations presented herein. If other soil types will be used as backfill, we should be notified so that appropriate modifications to these values can be provided, as needed.

The lateral pressures imposed upon subgrade facilities will depend upon the relative rigidity and movement of the backfilled structure. Following are the recommended lateral pressure values, which also assume that the soil surface behind the wall is horizontal and that the backfill within 3 feet of the wall will be compacted with hand-operated compacting equipment.

CONDITION	STATIC (psf/ft)*	SEISMIC (psf/ft)**
Active Pressure (wall is allowed to yield, i.e. move away from the soil, with a minimum 0.001H movement/rotation at the top of the wall, where "H" is the total height of the wall)	38	16
At-Rest Pressure (wall is not allowed to yield)	60	N/A
Passive Pressure (wall moves into the soil)	475	130

*Equivalent Fluid Pressure (applied at 1/3 Height of Wall)
**Equivalent Fluid Pressure (added to static and applied at 1/3 Height of Wall)

9.0 FLOOR SLABS

Floor slabs may be established upon undisturbed, natural sand/gravel soils and/or on structural fill extending to suitable natural soils (same as for foundations). Under no circumstances shall floor slabs be established directly on any topsoil, undocumented fills, loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

In order to facilitate curing of the concrete, we recommend that floor slabs be directly underlain by at least 4 inches of "free-draining" fill, such as "pea" gravel or 3/4-inch to 1-inch minus, clean, gap-graded gravel. To help control normal shrinkage and stress cracking, the floor slabs should have the following features:

1. Adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints;
2. Frequent crack control joints; and
3. Non-rigid attachment of the slabs to foundation walls and bearing slabs.

10.0 DRAINAGE RECOMMENDATIONS

It is important to the long-term performance of foundations and floor slabs that water not be allowed to collect near the foundation walls and infiltrate into the underlying soils. We recommend the following:

1. All areas around each residence should be sloped to provide drainage away from the foundations. We recommend a minimum slope of 6 inches in the first 10 feet away from the structure. This slope should be maintained throughout the lifetime of the structure.

2. All roof drainage should be collected in rain gutters with downspouts designed to discharge at least 10 feet from the foundation walls or well beyond the backfill limits, whichever is greater.

3. Adequate compaction of the foundation backfill should be provided. We suggest a minimum of 90% of the maximum laboratory density as determined by ASTM D-1557. Water consolidation methods should not be used under any circumstances.

4. Landscape sprinklers should be aimed away from the foundation walls. The sprinkling systems should be designed with proper drainage and be well-maintained. Over watering should be avoided.

5. Other precautions that may become evident during construction.

11.0 PAVEMENTS

All pavement areas must be prepared as discussed above in **Section 6.1**. Under no circumstances shall pavements be established over topsoil, undocumented fills (if encountered), loose or disturbed soils, sod, rubbish, construction debris, other deleterious materials, frozen soils, or within ponded water.

We anticipate the natural sand/gravel soils will exhibit fair pavement support characteristics when saturated or nearly saturated. Based on our laboratory testing experience with similar soils, our pavement design utilized a California Bearing Ratio (CBR) of 8 for the natural sand/gravel soils.

MATERIAL	PAVEMENT SECTION THICKNESS (inches)					
	PARKING AREAS (1 ESAL per day)			DRIVE AREAS (3 ESAL'S per day)		
Asphalt	**3**	**3**	**---**	**3.5**	**3.5**	**---**
Concrete	**---**	**--**	**5**	**---**	**---**	**6**
Road-Base	**8**	**4**	**5**	**10**	**6**	**5**
Subbase	**0**	**6**	**0**	**0**	**6**	**0**
Total Thickness	**11**	**13**	**10**	**13.5**	**15.5**	**11**

Untreated base course (UTBC) should conform to city specifications, or to 1-inch-minus UDOT specifications for A–1-a/NP, and have a minimum CBR value of 70%. Material meeting our specification for structural fill can be used for subbase, as long as the fines content (percent passing No. 200 sieve) does not exceed 15%. Roadbase and subbase material should be compacted as recommended above in **Section 6.4**. Asphalt material generally should conform to APWA requirements, having a ½-inch maximum aggregate size, a 75-gyration Superpave mix containing no more than 15% of recycled asphalt (RAP) and a PG58-28 binder.

12.0 QUALITY CONTROL

We recommend that CMT be retained as part of a comprehensive quality control testing and observation program. With CMT on-site we can help facilitate implementation of our recommendations and address, in a timely manner, any subsurface conditions encountered which vary from those described in this report. Without such a program CMT cannot be responsible for application of our recommendations to subsurface conditions which may vary from those described herein. This program may include, but not necessarily be limited to, the following:

12.1 Field Observations

Observations should be completed during all phases of construction such as site preparation, foundation excavation, structural fill placement and concrete placement.

12.2 Fill Compaction

Compaction testing by CMT is required for all structural supporting fill materials. Maximum Dry Density (Modified Proctor, ASTM D-1557) tests should be requested by the contractor immediately after delivery of any fill materials. The maximum density information should then be used for field density tests on each lift as necessary to ensure that the required compaction is being achieved.

12.3 Excavations

All excavation procedures and processes should be observed by a geotechnical engineer from CMT or their representative. In addition, for the recommendations in this report to be valid, all backfill and structural fill placed in trenches and all pavements should be density tested by CMT. We recommend that freshly mixed concrete be tested by CMT in accordance with ASTM designations.

13.0 LIMITATIONS

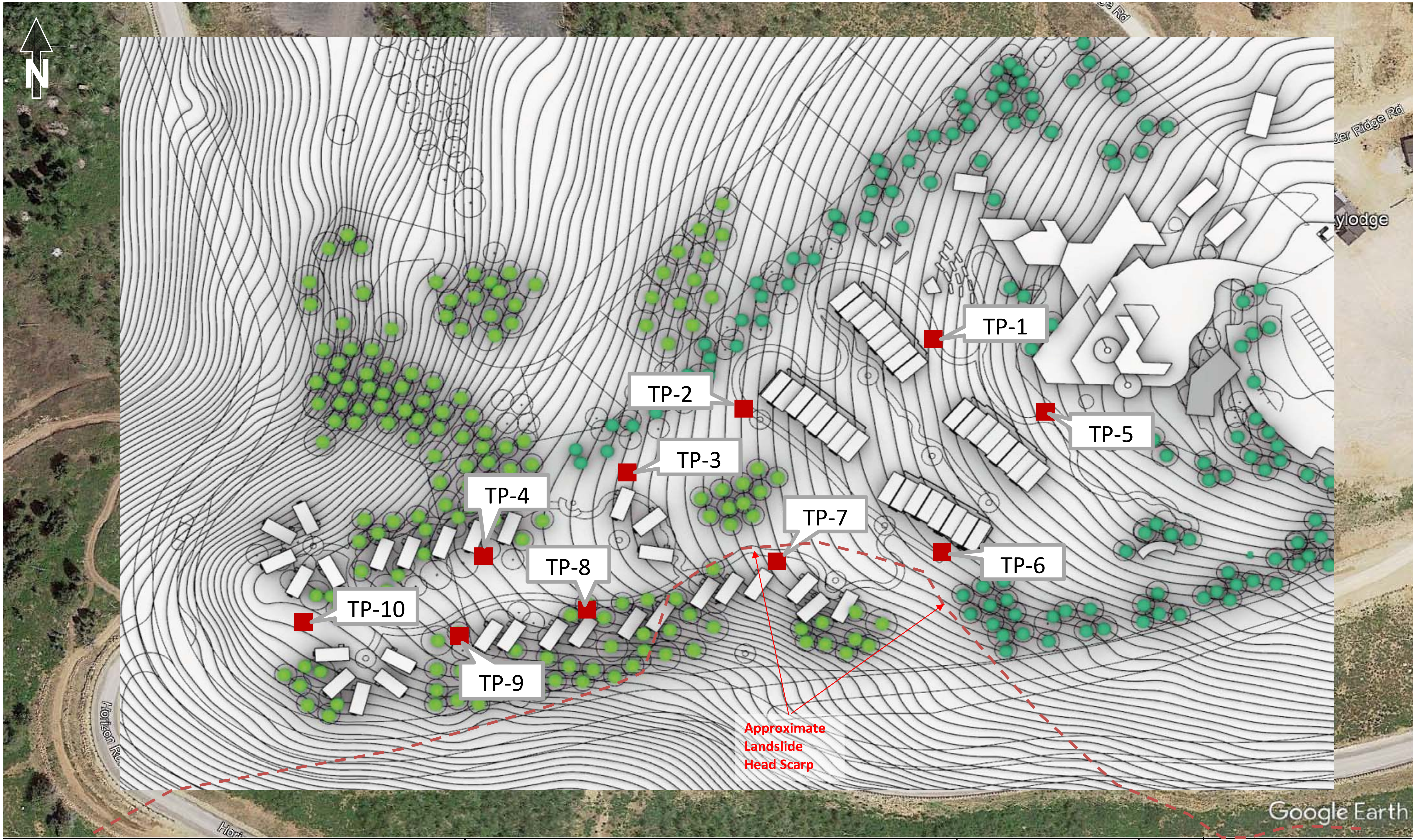
The recommendations provided herein were developed by evaluating the information obtained from the subsurface explorations and soils encountered therein. The exploration logs reflect the subsurface conditions only at the specific location at the particular time designated on the logs. Soil and ground water conditions may differ from conditions encountered at the actual exploration locations. The nature and extent of any variation in the explorations may not become evident until during the course of construction. If variations do appear, it may become necessary to re-evaluate the recommendations of this report after we have observed the variation.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

We appreciate the opportunity to be of service to you on this project. If we can be of further assistance or if you have any questions regarding this project, please do not hesitate to contact us at (801) 492-4132. To schedule materials testing, please call (801) 381-5141.

APPENDIX

SUPPORTING DOCUMENTATION



CMT TECHNICAL SERVICES

Skylodge Additions at Powder Mountain
About 7600 East Powder Ridge Road, Eden, utah

SITE MAP

Date:	22-Nov-2022
CMT No.:	19513

Figure:
1

Skylodge Additions at Powder Mountain

About 7600 East Powder Ridge Road, Eden, Utah

Test Pit Log

TP-1

Total Depth: 4'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0	▨	6" Topsoil										
1	▨	Brown Clayey GRAVEL with sand (GC), some cobbles moist, medium dense (estimated)										
2	▨		◢	1	11		45	27	28			
3	▨	Red Silty Clayey GRAVEL with sand (GC-GM), some cobbles and boulders moist, medium dense (estimated)	◢	2	3		53	24	23	26	19	7
4		END AT 4'										
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.3693°, -111.76614°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Figure:
2

Skylodge Additions at Powder Mountain

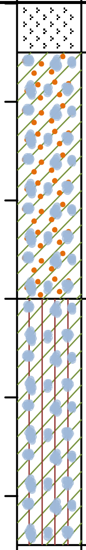
Test Pit Log

TP-2

About 7600 East Powder Ridge Road, Eden, Utah

Total Depth: 5.5'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513



Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Sand %	Fines %	Atterberg LL	PL	PI
0		6" Topsoil										
1		Brown Clayey GRAVEL with sand (GC), some cobbles moist, medium dense (estimated)										
2			◣	3	8		37	31	32			
3		Red Silty Clayey GRAVEL with sand (GC-GM), some cobbles and boulders very moist, medium dense (estimated)										
4												
5			◣	4	27		52	25	23			
		REFUSAL AT 5.5'										
6												
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.36909°, -111.76694°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Figure:
3

Skylodge Additions at Powder Mountain

Test Pit Log

TP-3

About 7600 East Powder Ridge Road, Eden, Utah

Total Depth: 4'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		6" Topsoil										
		Red Brown Silty GRAVEL with sand (GM) moist, medium dense (estimated)										
1			◣	5	7		41	33	26		NP	NP
2												
		grades with some boulders										
3		slightly moist	◣	6	5		51	26	23			
4		REFUSAL AT 4'										
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.36889°, -111.767355°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Figure:
4

Skylodge Additions at Powder Mountain

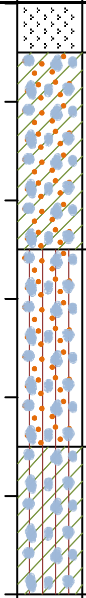
About 7600 East Powder Ridge Road, Eden, Utah

Test Pit Log

TP-4

Total Depth: 6'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513



Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0		6" Topsoil										
1		Brown Clayey GRAVEL with sand (GC), some cobbles moist, medium dense (estimated)										
2			◣	7								
3		Red Brown Silty GRAVEL with sand (GM), some cobbles moist, medium dense (estimated)										
4			◣	8	9		39	30	31			
5		Red Silty Clayey GRAVEL with sand (GC-GM), some cobbles/fractured bedrock slightly moist, medium dense (estimated)										
		grades with large boulders	◣	9								
6		REFUSAL AT 6'										
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.36863°, -111.76791°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Page: 1 of 1

Figure:
5

Skylodge Additions at Powder Mountain

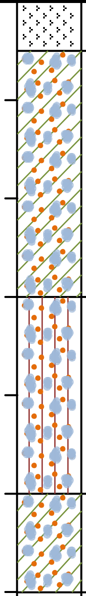
Test Pit Log

TP-5

About 7600 East Powder Ridge Road, Eden, Utah

Total Depth: 6'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0		6" Topsoil										
		Brown Clayey GRAVEL with sand (GC), some cobbles moist, medium dense (estimated)										
1												
2												
3		Light Brown Silty SAND with Gravel (SM), some cobbles slightly moist, medium dense (estimated)										
4			◢	10								
5		Brown Clayey GRAVEL with sand (GC), some cobbles/fractured bedrock moist, medium dense (estimated) grades with large boulders										
			◢	11	6		31	29	40	27	15	12
6		REFUSAL AT 6'										
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.36907°, -111.76566°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Figure:
6

Skylodge Additions at Powder Mountain

Test Pit Log

TP-6

About 7600 East Powder Ridge Road, Eden, Utah

Total Depth: 4'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Sand %	Fines %	Atterberg LL	PL	PI
0		6" Topsoil										
		Brown Clayey GRAVEL with sand (GC), some cobbles/fractured bedrock moist, medium dense (estimated)										
1												
2			◢	12	9		47	27	26			
		Light Brown Silty SAND with Gravel (SM), some cobbles slightly moist, medium dense (estimated)										
3												
		grades with large boulders	◢	13								
4		REFUSAL AT 4'										
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.36863°, -111.76612°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Figure: 7

Skylodge Additions at Powder Mountain

Test Pit Log

TP-7

About 7600 East Powder Ridge Road, Eden, Utah

Total Depth: 5'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg LL	Atterberg PL	Atterberg PI
0		6" Topsoil										
1		Brown Clayey GRAVEL with sand (GC), some cobbles moist, medium dense (estimated)										
2			◣	14								
3		Red to Light Brown Silty SAND with Gravel (SM), some cobbles slightly moist, medium dense (estimated)										
4			◣	15								
5		Red Brown Silty Clayey GRAVEL with sand (GC-GM), some cobbles/fractured bedrock slightly moist, medium dense (estimated)	◣	16	4		56	23	21	20	14	6
		REFUSAL AT 5'										
6												
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.3686°, -111.76675°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Figure: 8

Skylodge Additions at Powder Mountain

About 7600 East Powder Ridge Road, Eden, Utah

Test Pit Log

TP-8

Total Depth: 5'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0	░	6" Topsoil										
1	▨	Red Brown Clayey GRAVEL with sand (GC), some cobbles moist, medium dense (estimated)										
2	▨		◢	17	10		47	30	23			
3	▨											
4	▨	grades red in color, with large boulders	◢	18								
5		REFUSAL AT 5'										
6												
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.36846°, -111.76749°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Skylodge Additions at Powder Mountain

Test Pit Log

TP-9

About 7600 East Powder Ridge Road, Eden, Utah

Total Depth: 5'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation			Atterberg		
							Gravel %	Sand %	Fines %	LL	PL	PI
0	⁘	6" Topsoil										
1	▨	Brown Clayey GRAVEL with sand (GC), some cobbles moist, medium dense (estimated)										
2	▨		◢	19								
3	▨	Red Gravelly CLAY (CL), some cobbles slightly moist, stiff (estimated)										
4	▨	grades with large boulders	◢	20	6		44	2	54	23	15	8
5		REFUSAL AT 5'										
6												
7												
8												
9												
10												
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.36838°, -111.768°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Figure:
10

Skylodge Additions at Powder Mountain

Test Pit Log

TP-10

About 7600 East Powder Ridge Road, Eden, Utah

Total Depth: 10'
Water Depth: (see Remarks)

Date: 11/15/22
Job #: 19513

Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gradation Gravel %	 Sand %	 Fines %	Atterberg LL	 PL	 PI
0	⁙	6" Topsoil										
	▨	Brown Clayey GRAVEL with sand (GC), some cobbles moist, medium dense (estimated)										
1	▨											
2	▨	grades red brown	◢	21								
3	▨											
4	▨											
5	▨											
6	▨											
7	▥	Light Brown Silty SAND with Gravel (SM), some cobbles slightly moist, medium dense (estimated)										
8	▥											
9	▥		◢	22	3		34	37	29			
10		END AT 10'										
11												
12												
13												
14												

Remarks: Groundwater not encountered during excavation.

Coordinates: 41.36843°, -111.76861°
Surface Elev. (approx): Not Given

Equipment: Backhoe
Excavated By: Blaine Hone Excavating
Logged By: Steve Laird

CMT TECHNICAL SERVICES

Page: 1 of 1

Figure: 11

Skylodge Additions at Powder Mountain

About 7600 East Powder Ridge Road, Eden, Utah

Key to Symbols

Date: 11/15/22
Job #: 19513

①	②	③	④	⑤	⑥	⑦	Gradation ⑧			Atterberg ⑨		
Depth (ft)	GRAPHIC LOG	Soil Description	Sample Type	Sample #	Moisture (%)	Dry Density(pcf)	Gravel %	Sand %	Fines %	LL	PL	PI

COLUMN DESCRIPTIONS

① **Depth (ft.):** Depth (feet) below the ground surface (including groundwater depth - see below right).

② **Graphic Log:** Graphic depicting type of soil encountered (see ② below).

③ **Soil Description:** Description of soils, including Unified Soil Classification Symbol (see below).

④ **Sample Type:** Type of soil sample collected; sampler symbols are explained below-right.

⑤ **Sample #:** Consecutive numbering of soil samples collected during field exploration.

⑥ **Moisture (%):** Water content of soil sample measured in laboratory (percentage of dry weight).

⑦ **Dry Density (pcf):** The dry density of a soil measured in laboratory (pounds per cubic foot).

⑧ **Gradation:** Percentages of Gravel, Sand and Fines (Silt/Clay), obtained from lab test results of soil passing the No. 4 and No. 200 sieves.

⑨ **Atterberg:** Individual descriptions of Atterberg Tests are as follows:

LL = Liquid Limit (%): Water content at which a soil changes from plastic to liquid behavior.

PL = Plastic Limit (%): Water content at which a soil changes from liquid to plastic behavior.

PI = Plasticity Index (%): Range of water content at which a soil exhibits plastic properties (= Liquid Limit - Plastic Limit).

STRATIFICATION	
Description	**Thickness**
Seam	Up to ½ inch
Lense	Up to 12 inches
Layer	Greater than 12 in.
Occasional	1 or less per foot
Frequent	More than 1 per foot

MODIFIERS
Trace
<5%
Some
5-12%
With
> 12%

MOISTURE CONTENT
Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp / moist to the touch, but no visible water.
Wet: Visible water, usually soil below groundwater.

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)

MAJOR DIVISIONS			USCS SYMBOLS	②	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS More than 50% of material is larger than No. 200 sieve size.	**GRAVELS** The coarse fraction retained on No. 4 sieve.	**CLEAN GRAVELS** (< 5% fines)	GW	▨	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			GP	▨	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
		GRAVELS WITH FINES (≥ 12% fines)	GM	▨	Silty Gravels, Gravel-Sand-Silt Mixtures
			GC	▨	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SANDS The coarse fraction passing through No. 4 sieve.	**CLEAN SANDS** (< 5% fines)	SW	▨	Well-Graded Sands, Gravelly Sands, Little or No Fines
			SP	▨	Poorly-Graded Sands, Gravelly Sands, Little or No Fines
		SANDS WITH FINES (≥ 12% fines)	SM	▨	Silty Sands, Sand-Silt Mixtures
			SC	▨	Clayey Sands, Sand-Clay Mixtures
FINE-GRAINED SOILS More than 50% of material is smaller than No. 200 sieve size.	**SILTS AND CLAYS** Liquid Limit less than 50%		ML	▨	Inorganic Silts and Sandy Silts with No Plasticity or Clayey Silts with Slight Plasticity
			CL	▨	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	▨	Organic Silts and Organic Silty Clays of Low Plasticity
	SILTS AND CLAYS Liquid Limit greater than 50%		MH	▨	Inorganic Silts, Micacious or Diatomacious Fine Sand or Silty Soils
			CH	▨	Inorganic Clays of High Plasticity, Fat Clays
			OH	▨	Organic Silts and Organic Clays of Medium to High Plasticity
HIGHLY ORGANIC SOILS			PT	▨	Peat, Soils with High Organic Contents

Note: Dual Symbols are used to indicate borderline soil classifications (i.e. GP-GM, SC-SM, etc.).

SAMPLER SYMBOLS

◨	Block Sample
◪	Bulk/Bag Sample
⧗	Modified California Sampler 3.5" OD, 2.42" ID
⧗	D&M Sampler
◫	Rock Core
◪	Standard Penetration Split Spoon Sampler
▥	Thin Wall (Shelby Tube)

WATER SYMBOL

▽	Encountered Water Level
▼	Measured Water Level

(see Remarks on Logs)

1. The results of laboratory tests on the samples collected are shown on the logs at the respective sample depths.
2. The subsurface conditions represented on the logs are for the locations specified. Caution should be exercised if interpolating between or extrapolating beyond the exploration locations.
3. The information presented on each log is subject to the limitations, conclusions, and recommendations presented in this report.

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Figure:
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